# Input Devices

- **Keyboard**  ------for entering text
- **Mouse**
- **Trackball**        to control on screen movements
- **Joystick**
- **Scanner**                input of detailed positional info.
- **Barcode Reader**
- **Data Glove**
- **Light Pen**        three dimensional digitizers
- **Touch Screen**

# Keyboard Layouts

•A keyboard is a bank of switches whose individual states can be detected by the computer system.

•A series of single state switches on any domestic electrical appliance can be regarded as a keyboard.

•QWERTY keyboard

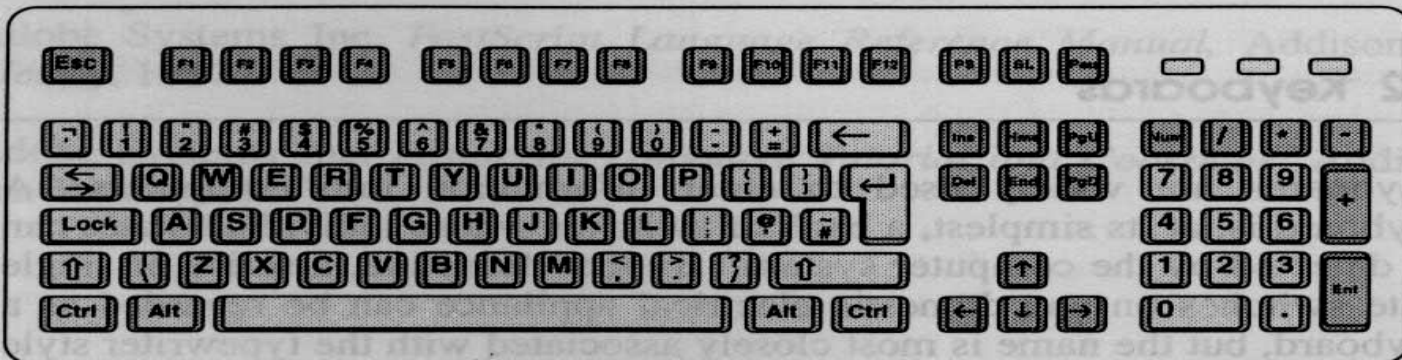•Can produce all characters in the common character sets such as ASCII.
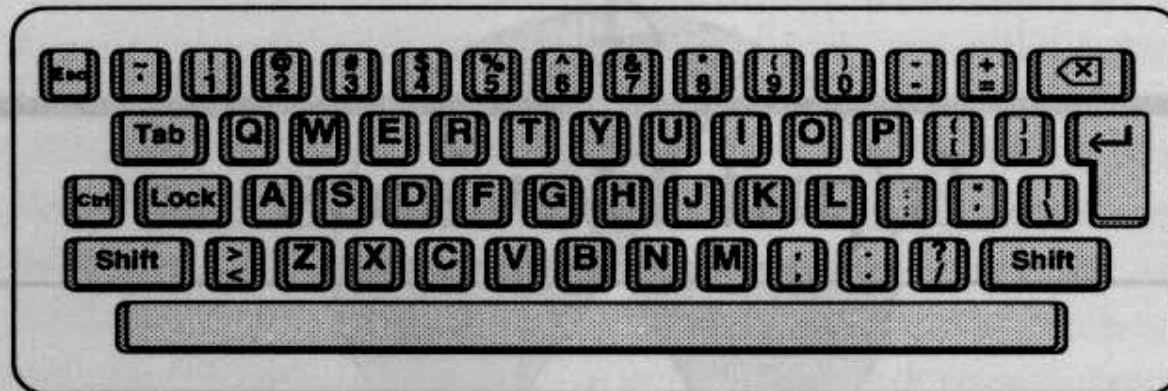


(a) Alphanumeric typewriter style keyboard

# Keyboard Layouts
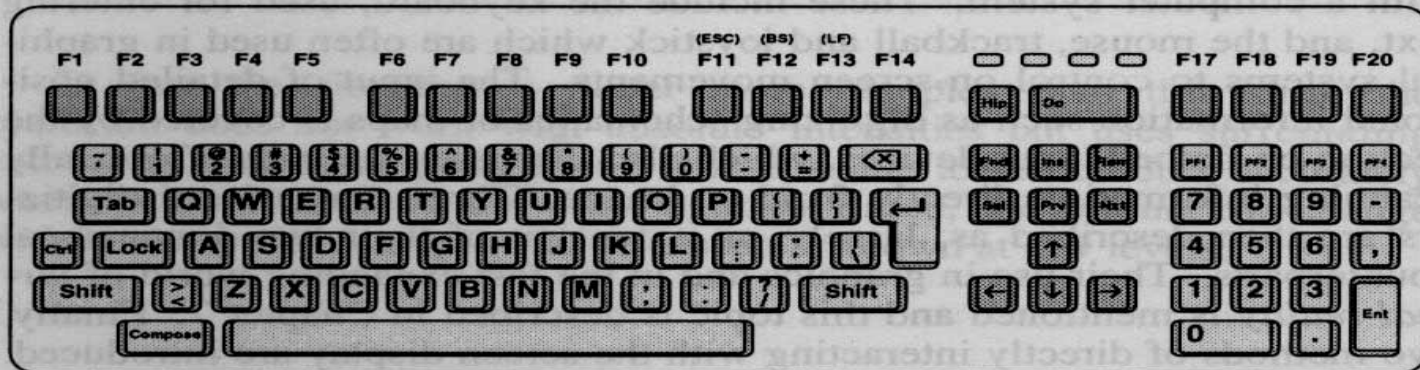


(b) Typical terminal keyboard

(c) Typical PC keyboard

**Figure 4.1** *Keyboard layouts*

# Contact Type Keyboard Switch

- **Widely used switches.**

- **Pressing the key plunger causes the contacts to touch and to produce a voltage.**

•Key bounce --- contacts may the bounce when plunger is depressed giving the appearance of several rapid key depressions.This effect is known as key bounce. This must be eliminated by special circuitry which effectively ignores the key after its first depression for a very short period of time.

Key plunger

Return spring

Electrical contacts

**Figure 4.2** *Contact type keyboard switch*
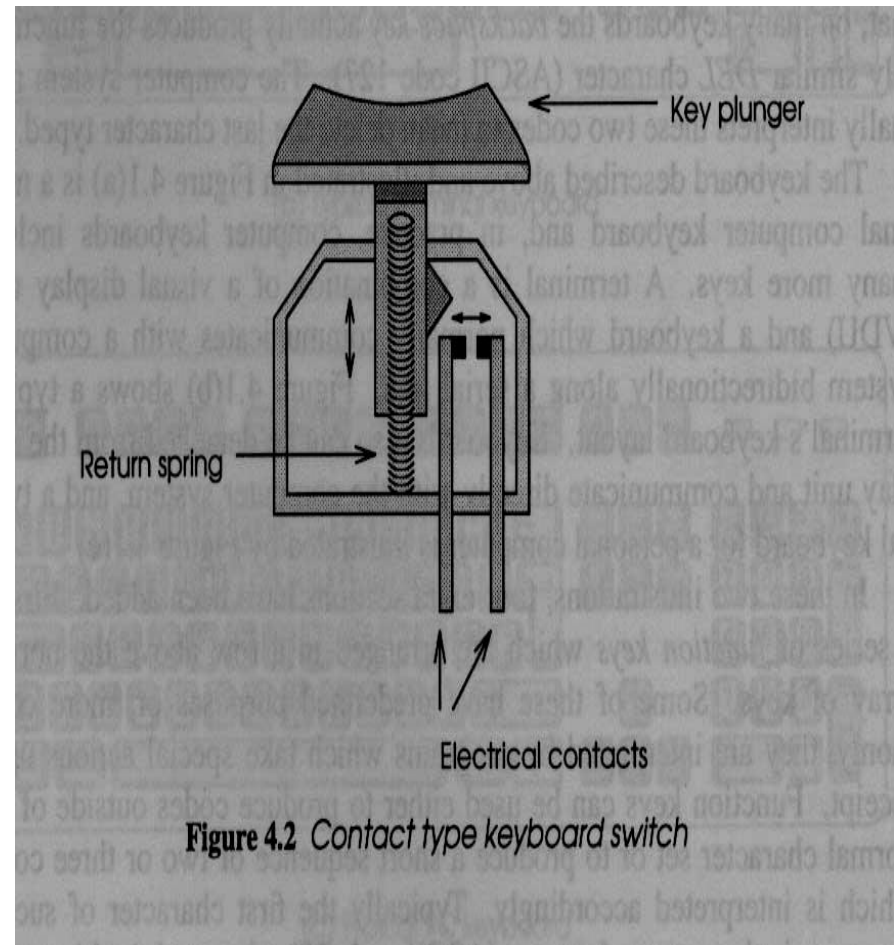
# Membrane Switch (Contact switch)

- Generally contains three layers of material such as polyester or polycarbonate film.
- The whole assembly is often less than 1mm thick.
- The bottom layer is fixed, the middle layer is flexible and the top layer, which is also flexible.
- The switch contacts are between the inner surfaces of the bottom layer and the middle layer.
- Pressing the top layer causes the middle layer to press against the bottom layer and form an electrical contact.
- When the top layer is released, the contact is broken.
- Membrane switches are inexpensive, thin, inherently sealed and can be waterproof.
- Often used for control switches on peripherals such as printers.

# Hall Effect Key Switch

**Of the Non-contacting switches Hall effect switches are popular.**



**Figure 4.3** *Hall effect key switch*
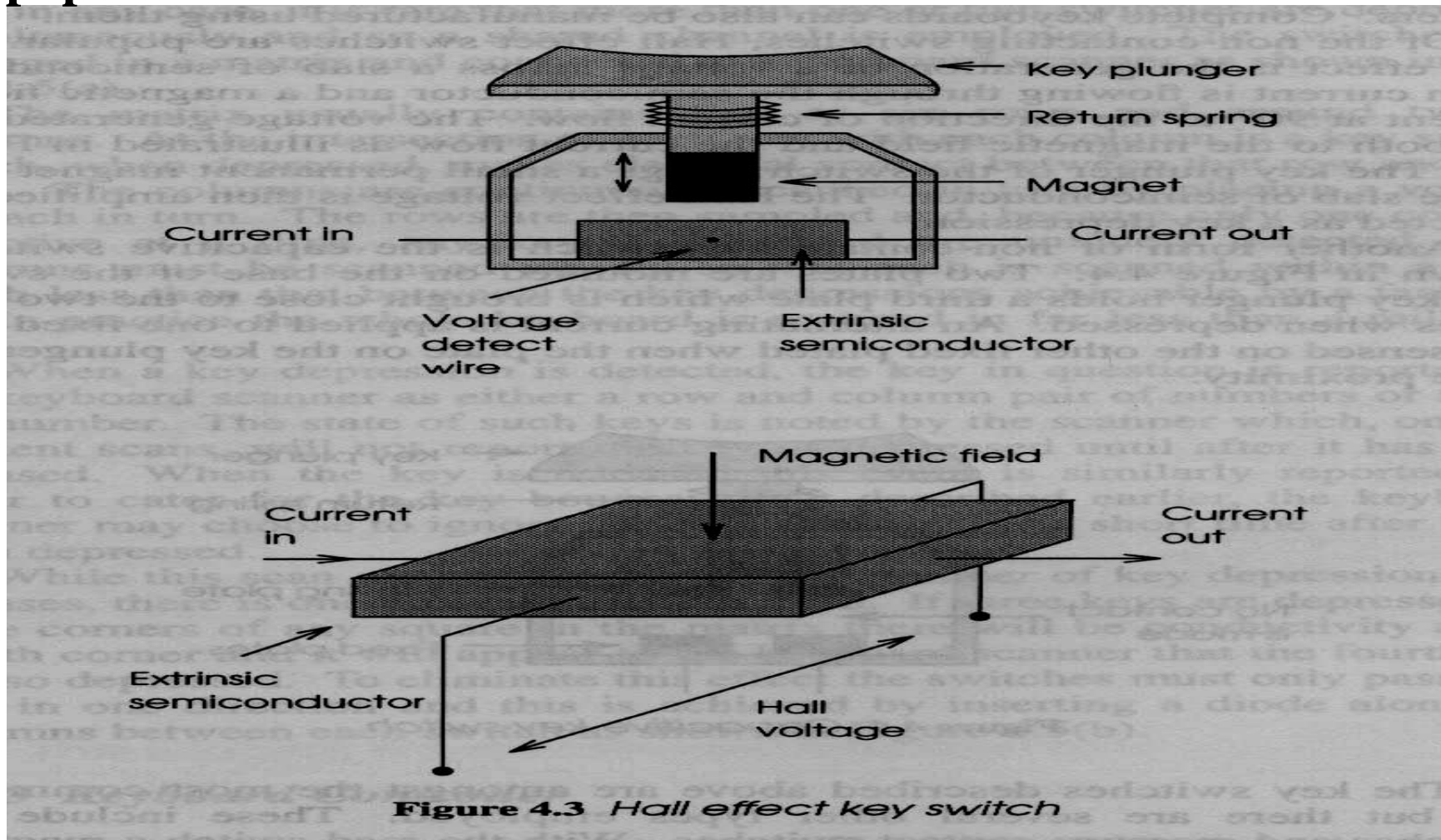
# Hall Effect Key Switch

- Hall effect is the generation of a voltage across a slab of semiconductor when current is flowing through the semiconductor and a magnetic field is present at $90^0$ to the direction of current flow.

- The voltage generated is at $90^0$ both to the magnetic field and the current flow.

- The key plunger of the switch brings a small permanent magnet close to the slab of semiconductor.The Hall effect voltage is then amplified and detected as a key depression.

# Capacitive Key Switch (Non-contact key switch)

•**Two plates are mounted on the base of the switch.**

•**The key plunger holds a third plate which is brought close to the two fixed plates when depressed.**

Figure 4.4 Capacitive key switch
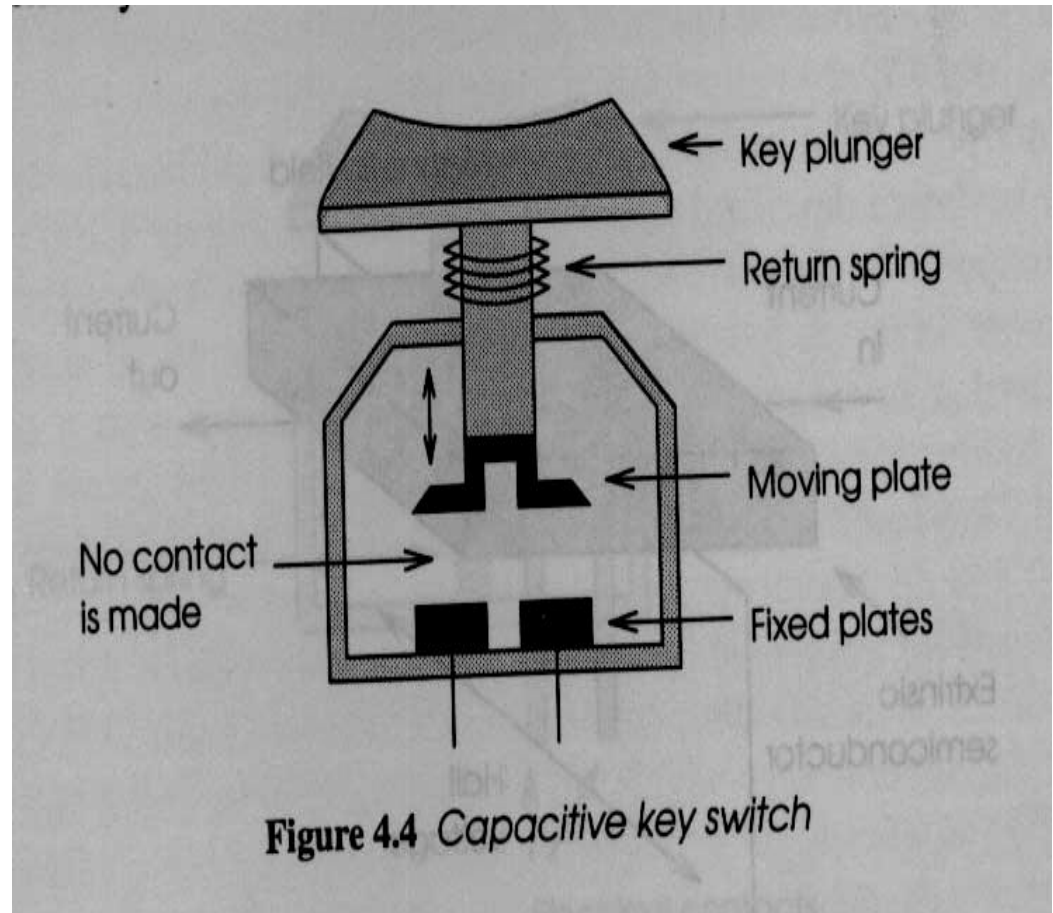
# Capacitive Key Switch (Non-contact key switch)…

Capacitive key Non-mechanical because they do not physically complete a circuit like most other keyboard technologies. Instead, current constantly flows through all parts of the key matrix. Each key is spring-loaded and has a tiny plate attached to the bottom of it. When you press a key, it moves this plate closer to the plates below it. As the two plates move closer together, the amount of current flowing through the matrix changes. The processor detects the change and interprets it as a key press for that location. Capacitive switch keyboards are expensive, but they have a longer life than any other keyboard. Also, they do not have problems with bounce since the two surfaces never come into actual contact.

# Keyboard Matrix Scanner



(a) Keyboard matrix scanner
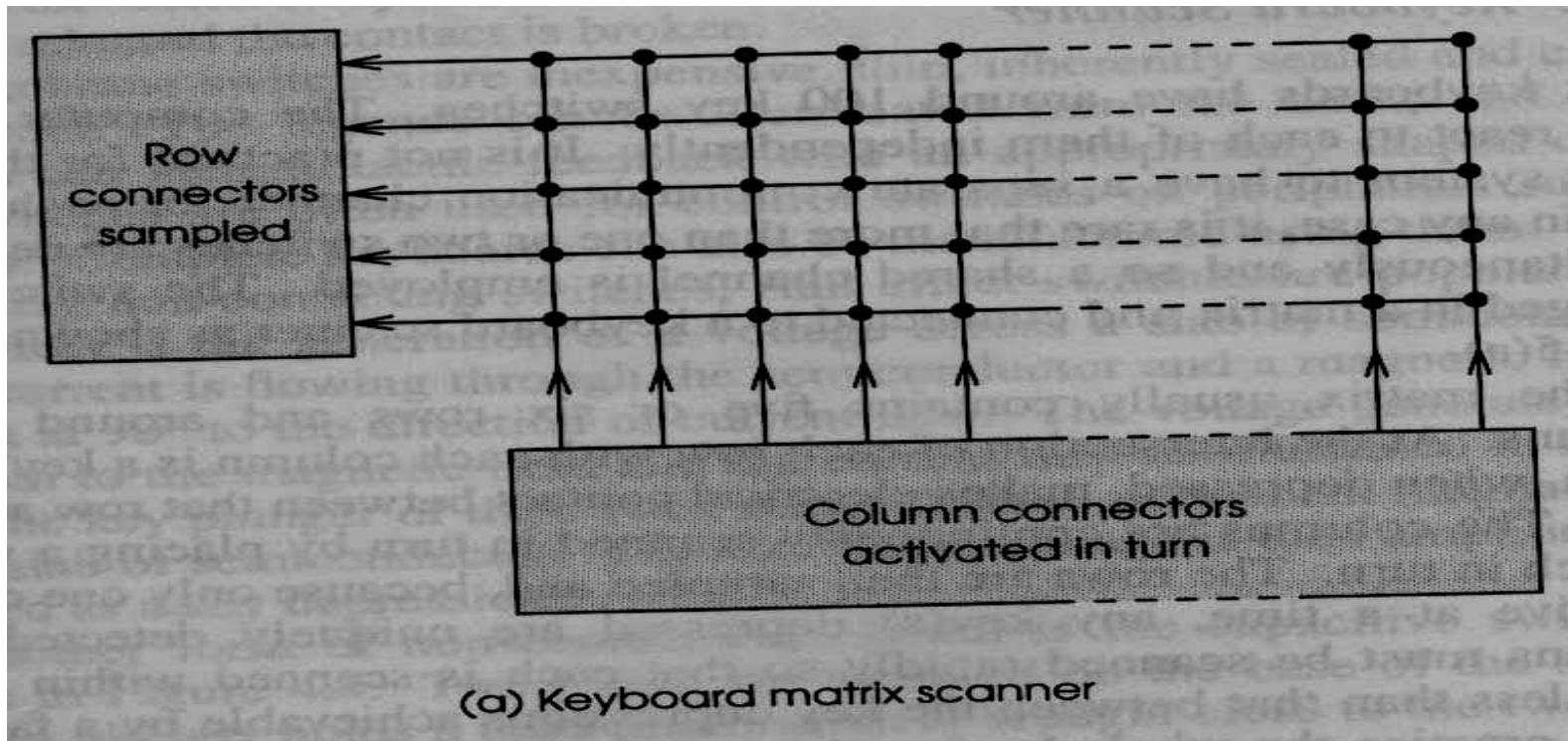
# Keyboard Matrix Scanner

•Most keyboards have around 100 keys. The computer system must react to each of them independently.

•But it is not possible to have a separate communication channel for each switch.

•So the switches are arranged in a matrix and connected to a keyboard scanner.

•The matrix usually contains 5 or 6 rows and around 20 columns.

•At the intersection of each row with each column is a key switch which ,when depressed ,makes electrical contact between that row and column.

# Keyboard Matrix Scanner

- The columns are continuously scanned in turn by placing a voltage on each in turn.

- The rows are then sampled and because only one column is active at a time, any key depressed is uniquely detected.

- The columns must be scanned rapidly (far less than a millisecond) so that each is scanned within a time much less than that between the key depressions achievable by a fast typist .

- When a key depression is detected, the key is reported by the keyboard scanner as either a row and column pair of numbers or a single number.

# Keyboard Matrix Scanner

•When the key is released this event is similarly reported.

•To ignore the effect of key bounce, the keyboard scanner may choose to ignore the state of a key for a short time after it has been depressed.

•This scan method can report any number of key depressions and releases.

•The key matrix is a grid of circuits underneath the keys. In all keyboards (except for capacitive models), each circuit is broken at a point below each key. When you press a key, it presses a switch, completing the circuit and allowing a tiny amount of current to flow through. If you press and hold a key, it is recognized as the equivalent of pressing a key repeatedly.

•The keyboard scanner produces key depression and release messages identifying the key by its position in the matrix.

•This information may be passed to the computer directly or after some processing.

•This processing is done by keyboard controller that may be located in keyboard housing and in case of PC it is housed in the main system unit. This is an integrated circuit (IC) that processes all of the data that comes from the keyboard and forwards it to the operating system.

# Keyboard Controller Interface

- There are three principal functions to be performed.
- First, the key identified by the position in the matrix, must be translated to a code for that character such as its ASCII code.This can be performed using look-up table. When the processor finds a circuit that is closed, it compares the location of that circuit on the key matrix to the character map in its read- only memory (ROM). A character map is basically a comparison chart or lookup table.
- Secondly keys such as Shift , Control must be interpreted.When Shift is depressed a different look-up table will be used until it is released.
- Thirdly, production of multiple characters for a single key depression. It produces a character repeatedly if a key is held down.
- Thus the controller receives a series of events relating to key depressions and releases and sends a series of character codes to the system.

# Keyboard Controller Interface



Figure 4.6 Keyboard controller interface
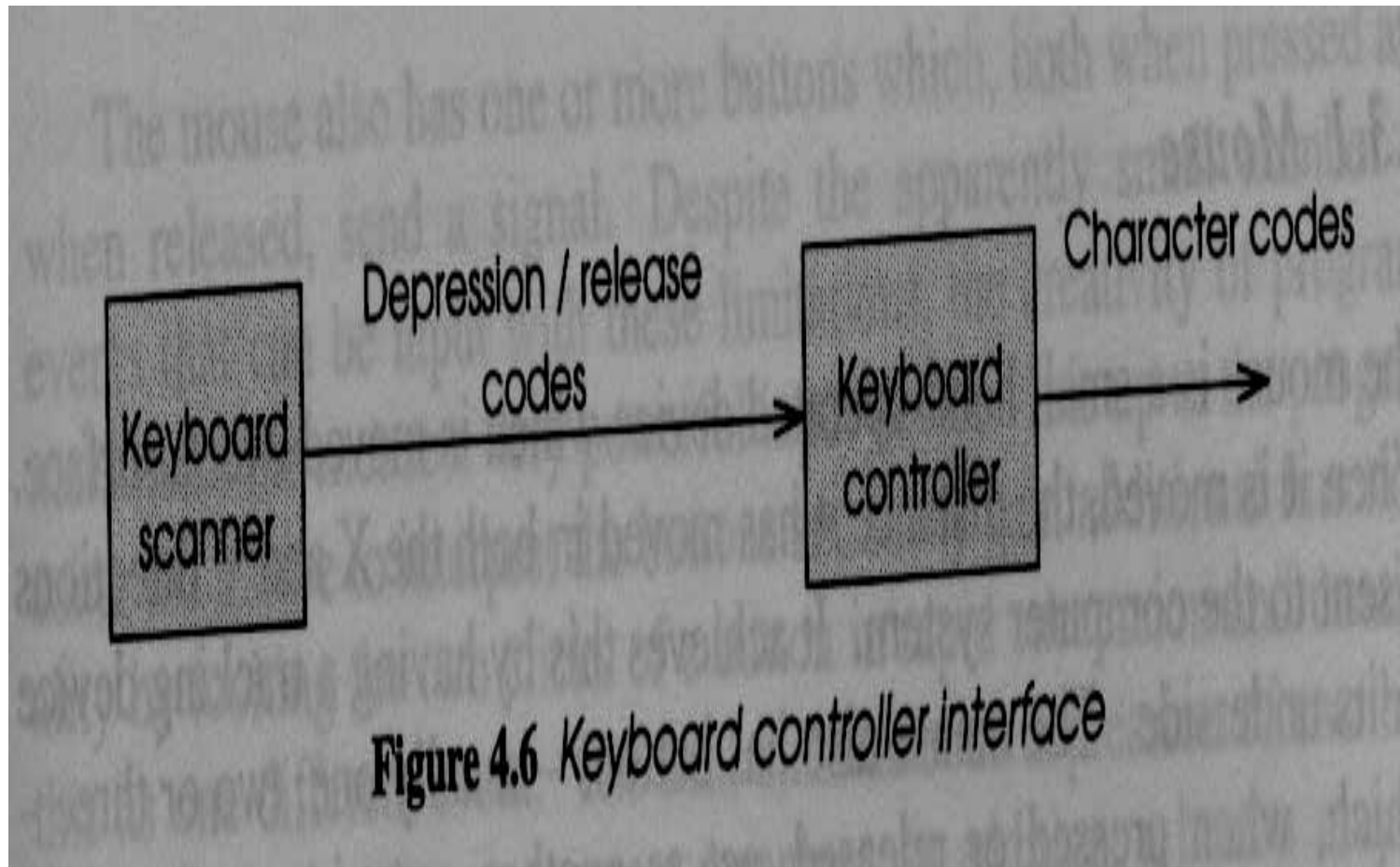
# From the Keyboard to the Computer

•When the operating system (OS) is notified that there is data from the keyboard, it checks to see if the keyboard data is a **system level command**. A good example of this is **Ctrl-Alt-Delete** on a Windows computer, which reboots the system. Then, the OS passes the keyboard data on to the current application.

•The application determines whether the keyboard data is a command,  like **Alt-f**, which opens the File menu in a Windows application.

•If the data is not a command, the application accepts it as **content**, which can be anything from typing a document to performing a calculation. If the current application does not accept keyboard data, it simply ignores the information. This whole process, from pressing the key to entering content into an application, happens almost instantaneously.

# Trackball

•Internal design is almost identical to a mouse.

•Ball is completely free to rotate within its socket.

•Operated by the palm of the hand.

•Movements sensed by the ball being in contact with two rollers inside the casing in the same manner as a mechanical mouse.

•The roller's movements again are detected by sensing the rotations of discs attached to their ends.

•This sensing can be achieved by electrical contacts or by LEDs and photodetectors

•Commonly integrated into the casing of most laptop personal computers.



**Figure 4.12** A trackball
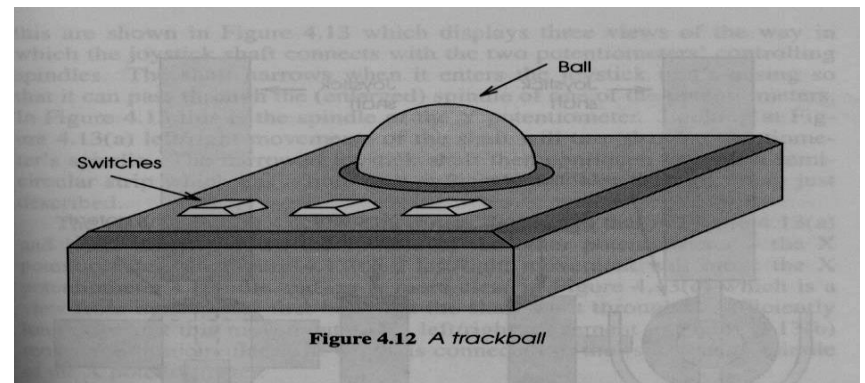
# Touch Screen

- A touch screen is a display screen which has something attached so that when a   finger touches the screen, the X and Y coordinates on the screen can be detected.
- The screen employs a row of transmitters on one side of the screen and a corresponding row of receivers  on the other side.  There are transmitter and receiver along the top and bottom of the screen.
- The transmitters are continuously sending a signal to their receivers.
- When the finger touches the screen , one or more receivers fail to receive the signal and the row-column touched are identified.

- A basic touch screen has three main components: a touch sensor, a controller, and a software driver. The touch screen is an input device, so it needs to be combined with a display and a PC or other device to make a complete touch input system.

### 1.Touch Sensor
A touch screen sensor is a clear glass panel with a touch responsive surface. The touch sensor/panel is placed over a display screen so that the responsive area of the panel covers the viewable area of the video screen. There are several different touch sensor technologies on the market today, each using a different method to detect touch input. The sensor generally has an electrical current or signal going through it and touching the screen causes a voltage or signal change. This voltage change is used to determine the location of the touch to the screen.

### 2.Controller
The controller is a small PC card that connects between the touch sensor and the PC. It takes information from the touch sensor and translates it into information that PC can understand. The controller is usually installed inside the monitor for integrated monitors.

### 3.Software Driver
The driver is a software update for the PC system that allows the touch screen and computer to work together. It tells the computer's operating system how to interpret the touch event information that is sent from the controller.